4.5.2 Demolition and Disposal

4.5.2.1 Overview

Decontamination and Decommissioning (D&D) is the series of activities that follows deactivation of a building, portions of a building, structures, or system components. D & D includes: "the surveillance, maintenance, decontamination, and/or dismantlement for the purpose of retiring the building from service with adequate regard for the health and safety of workers and the public and protection of the environment."

Work Organization and Cost

The D&D estimated direct cost for RFETS is addressed in PBDs 014 through 022. Each PBD relates to specific building clusters. In most cases, each cluster contains a set of multiple buildings related by proximity and/or functionality. The cluster groupings incorporate approximately 600 distinct buildings (or ancillary structures such as trailers, cooling towers and tents) located on site. According to the 2006 SPC, K-H has estimated that the D&D direct cost will be $755 million (unburdened and unescalated).

Estimating Methodology

K-H derived the total D&D estimate through a combination of "bottoms-up" and "top-down" estimating techniques. The "bottoms-up" approach is based upon quantitative data including unit prices for labor, material and equipment. Approximately 40% of dollar volume associated with D&D was estimated using this approach.

The "top-down" approach is based upon historical cost data from D&D activity already completed on site and accounts for the remaining 60% of dollar volume associated with D&D. The method used for deriving costs under this model were prescribed in a manual referred to as the Facilities Disposition Cost Model (FDCM).

It should be stressed that top down estimating applies *methodology* across a broad spectrum of work. Bottoms-up estimating, on the other hand, applies highly detailed and finite assumptions regarding buildings and their components to derive cost.

The determination to use one estimating approach or another was dependent upon a number of factors that will be discussed further below. In any event, once an estimate was prepared, K-H fed the input into the Basis of Estimate Software Tool ("BEST"). BEST is a RFETS tracking tool used to integrate cost and schedule.

K-H Organizing Principle: Levels of Contamination

In accordance with Rocky Flats Cleanup Agreement (RFCA), facilities are broadly classified based upon their contamination levels into three types as described in the following table.

Building Type	Description	Complexity and Cost Risk
Type 1	Free of contamination – mostly office trailers and administrative buildings	12%
Type 2	Without significant contamination or hazards. But in need of decontamination	21%
Type 3	With significant contamination or hazard.	68%

4.5.2.2 Methodology

The following discussion is the result of our review of the 2006 Closure Project Baseline for the D&D scope of work. The intent of this confidence review is to validate the basic methodologies that K-H employed to establish the schedule and cost integral to the PMP. The scale and complexity of the RFCP is such that a thorough examination of all D&D is neither feasible nor, given the intent, appropriate.

It is not intended to be a comprehensive review of all PBDs associated with D&D; instead, it is a representative review of specifically identified buildings which are either highly contaminated or otherwise indicative of K-H's methodology

Accordingly, we selected a number of buildings that we deemed "critical" or otherwise indicative of K-H's methodology for review as will be discussed further below.

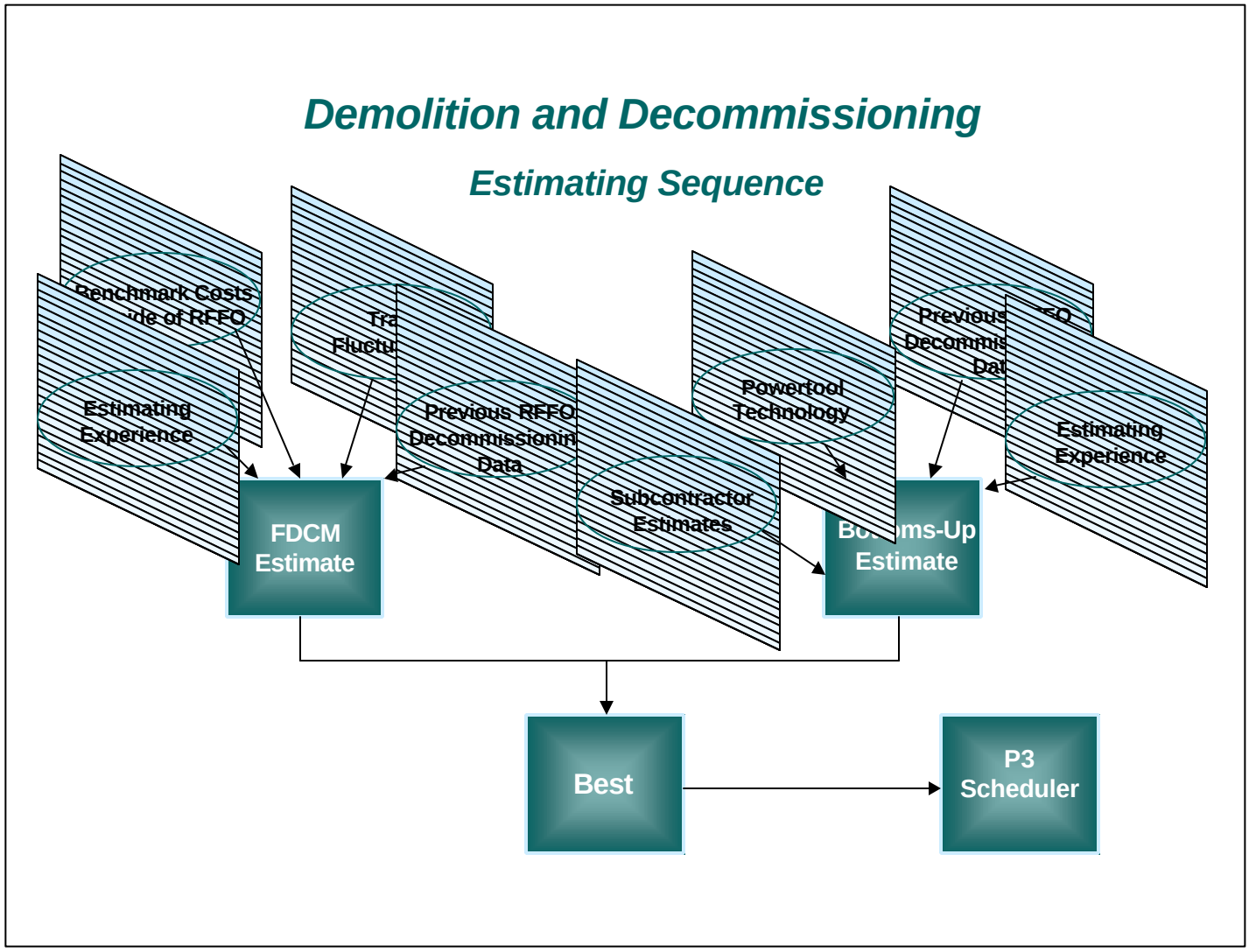
Criteria for Selection of Sample

The preponderance of D&D scope and estimated cost resides within selected Type III building clusters as follows:

1. Building 371;
2. Building 707;
3. Building 771;
4. Buildings 776/777; and,
5. Building 779.

Of these five, K-H selected the last three building clusters (771, 776/777 and 779) to perform a bottoms-up estimate. K-H also selected building clusters 444 and 886 for bottoms-up estimating. The latter two were selected because they are critical to the timely closure of the site due to their relationship with other operations.

In order to assess the completeness of scope, accuracy, methodology and consistency of estimating in general, we reviewed both the bottoms-up and top-down processes. For bottoms-


Demolition and Decommissioning
Estimating Sequence
Benchmark Costs
Estimating Experience
Previous RFFO Decommissionin Data
Powertool Technology
Subcontractor Estimates
Estimating Experience
FDCM Estimate
Estimate
Best
P3 Scheduler

up estimating, we reviewed, in some detail, four of the five estimates that were prepared. We did not review the estimate for Building Cluster 886.

We analyzed the "top-down" estimate produced from FDCM by reviewing, verifying and challenging historical data and estimating assumptions that K-H incorporated in the model.

Finally, we tested the BEST system to insure all completed "bottoms-up" and "top-down" estimates are accounted for and presented accurately.

A summary diagram showing the D&D process is included on the previous page. Specific inputs identified in the diagram will be discussed later in this section.

Support Documentation Review

After selecting PBDs, WADs, and WADlets corresponding to selected buildings and indicative of tops down methodology, we gathered support data pertaining to them which was available through the RFETS intranet network. These documents include but are not limited to the following:

- Project Baseline Descriptions ("PBDs") including Appendix A - Baseline Cost Detail, Appendix B - Change Control Logs, and Appendix C - Work Authorization Documents (by fiscal year);
- Basis of Estimates ("BOEs");
- Primavera Project Planner ("P3") scheduling data; and,
- Joshua, BEST, P&I Reporting database.

Interviews

Upon completion of the preliminary document review, we arranged interviews with key personnel from both the K-H project management team and the Department of Energy. Among other things, the interviews were conducted to confirm the assumptions identified in the PBDs, allow explanation of project management reasoning, discover client perceptions of services delivered and to clarify estimating controls and protocol.

Selective Building Tours

We made selected guided tours of Building 707, 371, 779 and 776/777. The purpose of the tours was to become familiar with the physical plant operations and to better appreciate constraints and encumbrances that are identified in the Bases of Estimate. Building 779 and Building 776/777 were selected based upon their relative status on the critical path to closure.

Analysis

After all support documents were reviewed, and interviews and inspections were completed, we compared K-H Project Management assumptions and planning to our fact-based findings and the perceptions of the K-H Project Team. We also used the "Joshua" (a proprietary K-H software package for budgeting and tracking costs) and P3 reporting tools to analyze how cash flows and resources correlated to key milestones.

4.5.2.3 Summary Findings and Concerns

K-H has made sufficient efforts identifying and quantifying various unknowns and knowns that may be expected during deconstruction of RFETS. Based on our review and analysis of the complexities and uncertainties for both scope and cost, we rate the overall confidence in D&D cost estimate of $755 million at a level of "medium". Our findings include both strengths and weaknesses, or exceptions identified within the "bottoms-up" and "top-down" estimates produced by K-H.

Strengths:

- The FDCM serves well as a rough order of magnitude estimate. It provides useful information necessary to determine resources and funding forecasts, when utilized it is a useful benchmarking tool against bottoms-up estimates.
- Rocky Flats D&D historical cost information has been incorporated into estimates and provides a strong basis for estimated costs.
- Adjustment factors (up/down) have been applied to identify expected learning curves, high levels of safety, complexity of work, and inefficiencies produced during constrained working conditions.
- D&D forecasts clearly identify scope of work and define all exclusions and assumptions made during the cost estimating efforts.
- Consistent use of unit costs has been demonstrated within individual "top-down" and "bottoms-up" estimates which are updated as new information is discovered.
- Technology (BEST) has been used effectively, and accurately reflects total estimated costs produced by building estimators and the FDCM development team.

Weaknesses:

- The "bottoms-up" estimates apply historical data generated from K-H's current cost reporting systems. As a result the cost control and reporting methods used provide weak support for their estimated costs.
- Due to the lack of cost information available, K-H's bottoms up estimates do not seem to make many provisions for scope uncertainties or the level of effort required for known scopes of work. K-H assumes that the project contingency will be used for all scope uncertainties rather than applying risk factors to the estimates.

- In terms of cost control and reporting effort, there is little evidence that K-H has made the transition to a deconstruction contractor. As the site moves away from being an operating facility and more towards a deconstruction project the level and type of cost control and reporting needs to become more focused on unit costs, thereby allowing management to better identify areas where increased efficiency is needed.
- There is inconsistency with the methodology used in developing the estimates. As the site becomes a decommissioning and deconstruction project, we observed that K-H does not use consistent procedures for the development of the various bottoms up cluster estimates. Because there are no established procedures, it becomes difficult to use one building's information for another building.

4.5.2.4 Level of Confidence

Background

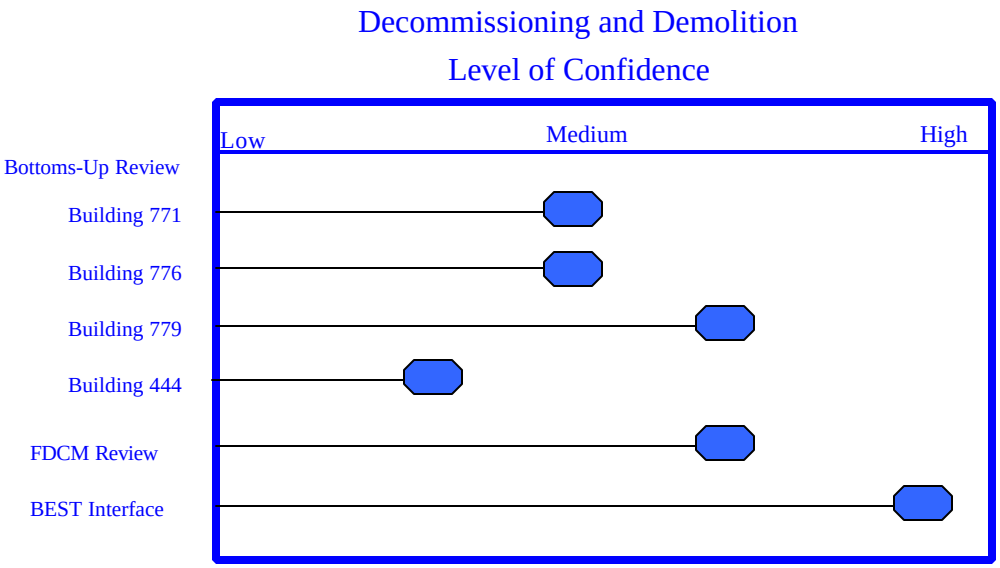
Based on the observations made during interviews, telephone conversations, policy manuals, and other material available for review, the following section provides a method of evaluating the D&D estimates performed in the K-H 2006 CPB.

We have derived the following estimate review areas based on the estimate type (top-down or bottoms-up) and their effectiveness. The evaluation scores range from low, medium and high, with high being best. These scores are based on the review and subjective evaluation of the information available at the time of this review. Since all areas are subjectively measured, and no area is deemed more important than another, each area is measured independently, and the overall score is an average of all individual areas.

This section is designed to evaluate actual estimate deliverables and test whether the finished product will meet the criteria discussed during our field interviews. This will provide the DOE with both a report on the general D&D estimating processes as described by the K-H representatives. The following illustration is the summary of results. All detailed scoring of the categories reviewed can be found under their associated heading in this report section.

Evaluation Summary

The following illustration is the summary of results. All detailed scoring of the categories reviewed can be found under their associated heading in this report section.



Level of Confidence Bottoms -Up Estimates

Comments on Level of Confidence

Building 779

- There is limited basis for the estimate and was reliant on estimator experience and assumptions.
- Did not rely on new technology for its completion.

Building 444

- It is unlikely that the current estimate adequately covers the scope for the building, while in its original issue it was defined in detail. Since then the schedule has been extended for this building as its priority has been reduced.
- No factors have been applied, the effects have been built into the rates for work in the Clean and Contaminated areas.
- The estimate has not been updated on a regular basis. This is the case even though there have been frequent changes made to its scheduled completion date.

Building 776

- Costs have been applied on a set by set basis. This has produced a variance in how the unit rates compare between sets.

Building 771

- It should be understood that though there is at least one allowance for each task, the generic nature does not assign mitigation to specific risks.

General Comments

- There will be some impacts, but these, whether positive or negative, have not been analyzed to produce a definite cost outcome.
- The methodologies were maintained within individual estimates as applied to specific building clusters. However, estimating methodologies vary among building clusters. Though some variation will occur due to differing building natures, the basic structure of a bottoms-up estimate should have the same elements within it. Use of variable approaches may result in omissions or discrepancies when attempting to allocate cost and resource the work.
- The methodology for applying efficiency factors is inconsistent (due to estimators' discretion). For example, Building 771 has factors applied across the board, while buildings 776 & 779 have factors applied to particular resources.
- Buildings 771 & 776 rely on new technology; Building 779 does not.

The following summarizes our opinion of the level of confidence.

#	Confidence Check	Building 771	Building 776	Building 779	Building 444
1	Estimating methodology clearly defined.	H	H	M	M
2	Scope for the building well established.	H	H	M	H/M
3	Unit Costs consistent within estimates.	H	H/M	H	H/M
4	Unit Costs consistent between estimates.	L	L/M	L/M	L
5	Out year cost impacts recognized.	L	L	N/A	L
6	Methodology consistent within the estimate.	H	H	H	H
7	Methodology consistent between estimates.	L	L	L	L
8	Consistent use of factors within buildings.	H	H	H	M
9	Consistent approach to factors between buildings.	L	L/M	L/M	L
10	Use of Technology.	L	L/M	N/A	L
11	Estimate updated.	M	M	H	L
	Average Ranking	**M**	**M**	**M/H**	**L/M**

L = The confidence is Low, though it does not infer that the subject is not already known or that there is no attempt to quantify its effects.

M = The confidence is Medium, inferring that there has been a distinct attempt to mitigate circumstances, but that there is still room for improvement in this area.

H = The confidence is High. The estimate has clearly defined how it has quantified the costs and resources therein, and has addressed the most critical aspects.

Level of Confidence Facilities Disposition Cost Model (FDCM)

Comments on Level of Confidence

The cost models goes into great detail to insure their methodology is clearly understood and sufficiently narrated.

Due to the unique nature of this project and the limited amount of both resource and cost information available K-H did a reasonable job based on the information available.. As more cost information becomes available K-H should update their cost information as much as possible.

The project management costs like all other unit costs are a function of the physical dimensions of the building and facilities. As this is now considered a closure project, project management costs should be estimated based on the level of effort required to manage the scope of work.

Item #	Confidence Check	FDCM Ranking
1	Estimating methodology clearly defined.	H
2	FDCM based on the available information identify the Key assumptions used.	H
3	FDCM establish a comprehensive work breakdown structure and is that structure consistent through out.	H
4	Factors consistent between the types of buildings or facilities being estimated.	H
5	Consistent approach to factors being used.	H
6	FDCM identifies the various types of facilities and buildings involved.	H
7	FDCM identifies the complexities and uncertainties with a project of the nature.	H
8	FDCM identifies the resource and costs associated with a project of this nature.	M
9	FDCM identifies the Project Management requirements.	M
	Average Ranking	**M/H**

L = The confidence is Low, though it does not infer that the subject is not already known or that there is no attempt to quantify its effects.

M = The confidence is Medium, inferring that there has been a distinct attempt to mitigate circumstances, but that there is still room for improvement in this area.

H = The confidence is High. The estimate has clearly defined how it has quantified the costs and resources therein, and has addressed the most critical aspects.

Level of Confidence – Basis of Estimate Software Tool (BEST)

The D&D estimates shown in BEST and used during the 2006 CPB are a true representation of forecasted costs produced during bottoms-up and top-down estimates. The detail within the Basis of Estimate supports the assumptions and quantity surveys made by K-H estimators at the time the information was produced.

Confidence Check	Ranking
WBS structure within BEST is consistent with FDCM.	H
All estimated D&D costs have been included in BEST.	H
WorkSets within BEST correspond to bottoms-up estimates	H
Like unit rates tested out against WBS elements.	H
Basis of Estimate detail is clear and concise.	M/H
Average Ranking	**H**

L = The confidence is Low, though it does not infer that the subject is not already known or makes no attempt to quantify its effects.
M = The confidence is Medium, inferring that there has been a distinct attempt to mitigate circumstances, but that there is still room for improvement in this area.
H = The confidence is high, the estimate has clearly defined how it has quantified the elements therein, and has addressed the most critical aspects.

4.5.2.5 Bottoms-Up Estimate Review

The purpose of a bottoms-up estimate is to produce certainty, both in cost and labor resources. The project is dissected element by element and assigned a cost based upon quantities for labor, materials, equipment requirements and sub-contract costs. Once base costs are established, productivity factors are applied to account for difficult circumstances, location, timing issues or other peculiarities related to the task.

The bottoms-up approach takes the proposed work from its most finite elements up to a complete analysis of the work scope. If certain quantities or rates are unavailable, an appropriate allowance is included to cover these elements. These basic components comprise the key information required to assess labor resourcing, allocate required funding, track cost and scheduling the work.

Approach

To assess the bottoms-up approach to estimating, we examined four of the five estimates prepared by K-H. In general, the follow key concerns were addressed:

- What methodology was used in deriving cost. We paid particular attention to K-H's consistency in approach to each set, as well as its assumptions and inclusions/exclusions.
- What consistencies or inconsistencies exist across sets.
- What salient differences in costs exist between the bottoms up estimates and those derived using the FDCM. Where are costs similar or dissimilar and why.

To further test the viability of bottoms-up estimating, we interviewed a number of K-H team members (including estimators) and developed an independent review of the build up to the estimates.

Analysis and Discussion

Building 771 Estimate Review

In brief, K-H's methodology used to derive the bottoms-up estimate for Building 771 incorporated the following:

1. K-H outlined the assumptions and activity flow for individual work items;
2. Generic unit rates were developed from actual experiences for known activities including duration, labor and material required. Where costs & resources were unknown an allowance was made.;
3. A detailed quantity survey was conducted of the building. To simplify this, K-H segregated the buildings into modules that were referred to as "Sets". In a number of cases, the "Sets" were rolled up into "Supersets";
4. Unit rates and quantities for distinct sets were fed into POWERtool (POWERtool is a proprietary database system designed for K-H to streamline quantities and costs inputs in the BEST system);
5. In POWERtool, total costs per activity were estimated including waste quantities produced and container requirements per waste type;
6. Project management and support services were added onto the base cost. It should be noted that project management cost was determined using a generic set rate, that is, a percentage of base cost was used to assess associated project management cost;
7. Data was reviewed, and corrected if necessary;
8. The output from POWERtool was input in the BEST system, where learning curve factors were applied to the activity man-hours; and,
9. When the bottoms-up estimates replaced FDCM estimates (which had previously been input in the BEST system as a "bookmark" until better data was available).

Observations:

Based upon our review of the estimate, we have the following comments.

- ***Planning and Integration*** – Building 776 is scheduled to include a Remote Robotic Waste Reduction Facility which will simplify and expedite the D&D of certain contaminated components. This equipment requires less manpower and is designed to be safer (i.e., self-contained). The estimate for this building does not recognize the potential use of this equipment. Additionally, K-H does not recognize the potential use of the Centralized Waste Reduction Facility ("CWRF") in their estimate.

  Should these technology improvements be implemented (and successful), they could have a significant affect on the D&D activities in this building. If this is not the case then there is a high degree of risk that the building D&D will not be complete on time without additional increases in manpower and other associated costs.

- ***Planning and Integration*** - We observed that the assumptions made for each work activity do not appear to conflict with the broader assumptions made in the FDCM. They relate specifically to each task.

- ***Rolling Wave Knowledge Incorporation*** - The bottoms-up estimate includes a level of detail that could allow for better tracking of costs incurred as the work progresses. As a result, meaningful estimating information can be garnered from this project for other buildings or future projects. Unfortunately, because the implementation of tasks will deviate from plan, the level of detail may not be leveraged to the extent hoped for (that is, since it was originally established as a generic model, the generic costs temper the value of having achieved such detail).

  This is an evolving estimate, where new technology and decommissioning methods are envisioned for use in the program, but which are not accounted for in this estimate. Once their use is approved, a better view of actual costs and future expenses can be seen. This dynamic approach to implementation has merit.

  This rolling wave evolution also applies to the basic premise of this estimate that there will be an efficiency factor of "1" and a crew factor of "1." These factors will need to be updated as the work progresses, as they appear to exaggerate the ease of completing this building cluster.

- ***Unit Rates*** - As we noted earlier, unit rates were developed for the D&D of certain property, plant and equipment. The unit rates are broadly defined to include "generic" components of D&D. As a result, they do not cover all eventualities due to the wide variations of scope in some tasks or components (for example, though glove-box construction varies tremendously across the building cluster, the unit costs apply irrespective of particular construction anomalies from box to box).

  The generic unit rates sometimes appear to produce exaggerated costs for those buildings within the 771 cluster which are not Type 3CA (that is, having significant contamination).

- ***Unit Rates and Efficiencies*** – K-H has done a good job to integrate the experiences of workers in the implementation of D&D. Due to the nature of the work, an assessment of the tasks by those actually conducting them is an invaluable tool. By leveraging worker knowledge, K-H has improved

the efficiency factor of "1." It should be noted that this efficiency was broadly or generically applied across all activities; this may not always be applicable.

- ***Unit Costs and Information Technology*** - The POWERtool system has been examined, and determined to include enough detail and safeguards to prevent errors in resourcing and pricing, as well as log any changes made to it. This is an important factor in the "rolling wave" concept of estimating. That is, when actual information becomes available it can be readily incorporated.

  A shortcoming in the software, however, is its reliance on the generic unit costs for individual activities. This of course can be remedied once actual costs for specific sets are known, but may result in an excessive amount of duplicative (i.e., redundant input for tasks already accounted for) input to the system.

- ***Cost Allocations*** – K-H calculated the D&D consumables such as small tools as a percentage of the total number of hours worked instead of calculating it based upon those of the workers actually involved in each task. This would not appear to be a good model for estimating.

  The estimate does not include any costs for Personal Protection Equipment ("PPE"). These are assumed to be within the landlord costs. However, the labor hours involved in putting on and taking off PPE are included in the unit rates, so any productivity inefficiencies are built into the unit costs for activities, although at a generic level.

- ***Overtime, Escalation and Contingency*** - The estimate excludes any overtime costs, escalation or contingency amounts.

- ***Characterization*** - The estimate appears to only include "in-process" characterization costs (but does not account for reconnaissance level characterization, which the FDCM contains).

Building 776 Estimate Review

1. K-H used the Decommissioning Operations Plan ("DOP") outline to identify activities. They then created a generic Excel template for each Set.
2. K-H set resource loading based on actual experiences of those conducting the work on a set by set basis. Rather than create a series of generic costs, each set was considered on an individual basis.
3. The factors for efficiency and PPE reductions in productivity were applied to each individual resource depending on levels required, while costs for PPE were included in the labor rates for only those workers requiring it.
4. Data was reviewed, and corrected if necessary.
5. The results for each set were then input into the BEST system within the WBS codes established.
6. No further factors were applied.
7. The bottoms-up estimates replaced FDCM estimates in BEST.

Observations:

Based upon our assessment we have the following comments.

- ***Planning and Integration*** – Building 776 is scheduled to include a Remote Robotic Waste Reduction Facility which will simplify and expedite the D&D of certain contaminated components. This equipment requires less manpower and is designed to be safer (i.e., self-contained). The estimate for this building does not recognize the potential use of this equipment. Additionally, K-H does not recognize the potential use of the Centralized Waste Reduction Facility ("CWRF") in their estimate.

  Should these technology improvements be implemented (and successful), they could have a significant affect on the D&D activities in this building. If this is not the case then there is a high degree of risk that the building D&D will not be complete on time without additional increases in manpower and other associated costs.

- ***Estimating Template*** – K-H created estimating template sheets for all D&D work including deactivation and project management for each set (it should noted that this is ancillary to the D&D work, and not related to the primary deactivation in the building). These outline the Deactivation and Project Management costs associated with each set. These were separated out for input into BEST under WBS codes 1.1.06.12.03 & 1.06.12.04.AA respectively.

- ***Project Funding*** – For FY00 there appears to be a shortfall in the monies required to fund the new size reduction technology. It is our understanding that K-H intends to finance this through the re-sequencing of several work sets, as well as through the change process. In other words, K-H plans to take one of the more difficult sets due to start and finish in FY00, and replace it with a less complex one. If this is the case, an artificial saving has been created which may offset the cost of the technology. However, this is a false economy, as the cost of the work moved to the out years may well be more expensive to complete at that time. It may even have the effect of pushing out the completion of subsequent work.

- ***Unit Rates*** – A consistent approach was used to develop the basic set sheets that give the associated costs for the work, per set only. Therefore a standard unit cost for activities is not available.

  Generic unit rates were not developed for building 776/777. Each set was treated as an individual entity and the costs and resources were estimated on that basis. Similar to building 771, this estimate also utilizes the assessment of the tasks by those actually conducting them. While developing the unit costs and resource loading required, the methodology is applied consistently, even though the unit rates differ vastly from set to set.

- ***Unit Rates and Efficiencies*** – K-H have approached the use of factors to account for difficult conditions in differing ways. For building 776 factors were included within their rates, (i.e., workers requiring PPE have been assessed differently to those not requiring it). In building 771, the costs of PPE have been assumed to be landlord costs. Similarly, the learning curve for building 776 has been included in the rates, while for building 771, learning curve is applied once the estimate reaches the BEST system.

- ***Cost Allocations*** – Consumables have been treated in different ways as well. In building 771, consumables are treated as a product of the total hours worked, while in building 776 a 15% markup on total labor cost has been applied. This is created from the total cost rather than from just those costs created by the workers actually involved in each task (i.e., with Radiation Technicians adding to this total cost). Both estimates cover the cost but in an inconsistent manner.
- ***Characterization*** – The estimate excludes any Characterization costs, which the FDCM contains.
- ***Overtime, Escalation and Contingency*** Escalation and contingency costs were excluded. In addition, even though the work was based on one shift, there are overtime costs in the estimate.

Building 779 Estimate Review

1. The estimate was created by RMRS, rather than by Kaiser-Hill.
2. Each area of the building was surveyed to determine the scope and type of work to be executed.
3. Where possible exact quantities for activities were extracted from drawings and from walkthroughs.
4. Unit rates were created from the estimators' experiences for activity durations and resources required, and from adjusted industry standard estimating information.
5. Where costs & resources were unknown an allowance was made.
6. Following the detailed survey of the building, the unit rates were applied, and factors for difficulty included. These were applied on a room by room basis dependent on the activities required.
7. Data was reviewed, and corrected if necessary.
8. Output from the estimate was put into the BEST system.
9. Bottoms-up estimates replaced FDCM estimates in BEST.

Observations:

- ***Unit Rates*** – The industrial information used to create the unit rates was mostly based on installation costs, therefore these required an adjustment to convert them into the appropriate decommissioning cost for each item.

  This was the first of the bottoms-up estimates to be completed, so much of the information used has been produced from experience and adjusted industry standards. An important question is how accurate the estimates are found when compared to actual data. As an evolving estimate in BEST there is a considerable amount of readjustment to estimated costs as actual information is added.

- ***Unit Rates and Efficiencies*** – No learning curve savings have been applied to the estimate as it was assumed that the learning curve was to be created from doing the work. There are landlord costs within the estimate. These should be highlighted in any comparison to other buildings.

- ***Rolling Wave Knowledge Incorporation*** – As the first Type 3 CA building to be decommissioned, Building 779 has been used by both the FDCM and other estimates to acquire actual data, and these data was used as a basis for all other Type 3 buildings, specifically for glove-box removal. However, it should be noted that Building 779 is one of the less complicated Type 3 CA buildings to have D&D performed. Therefore, there is still a reasonable amount of doubt as to its viability for extrapolating costs to some of the more complex PA buildings (e.g., the use of its glove-box costs may underestimate the complexity of some of the boxes in buildings like 771 and 776).
- ***Planning and Integration*** – Building 779 is being dismantled without the assistance of any waste reduction technology, therefore it is similar to the other bottoms-up estimates in what costs are included, but not in schedule.
- ***Characterization*** – Characterization costs are included in the estimate. This project developed most of the protocols for the characterization process that are now evolving into the standard for the site.
- ***Cost Allocations*** – Consumables have been calculated on a room by room basis, assessing what would be required for the relevant activities. These have been based on the estimator's experience and a calculation of levels of use based on the schedule.
- ***Escalation and Contingency*** – No escalation or contingency is included within the estimate.

Building 444 Estimate Review

1. The building was separated into Clean and Contaminated areas.
2. Standard crew sizes and equipment costs were then assigned to tasks within these two areas.
3. Unit rates were created from the estimators' experiences for activity durations and resources required, and from adjusted industry standard estimating information.
4. Productivity assumptions were made for clean and contaminated areas, and applied to the estimate.
5. Management and facilities costs were based on the schedule for the work sections.
6. Where costs and resources were unknown, an allowance was made.
7. A factor was included for the addition of a second shift to the Asbestos Abatement and Strip-out activities.
8. Data was reviewed, and corrected if necessary.
9. Output from the estimate was put into the BEST system.
10. Bottoms-up estimates replaced FDCM estimates in BEST.

Observations:

- ***Unit Rates*** – There appears to be no consistency between this estimate and those of the other buildings. No generic costs or resources can be identified as similar to those of other estimates. For certain activities, in particular Asbestos Abatement, rates have been based on the scheduled duration of the task, and the use of a standardized crew size for that period.

  Unit Rates and Efficiencies – In the FDCM there is a difficulty factor included from Table 7-1 to convert from Building 123 to a Type 2 CA. However, Building 444 is not as heavily contaminated as some of the other Type 2 CA buildings (contamination in Building 444 is Beryllium, rather than depleted Uranium), so therefore this factor may exaggerate the FDCM cost.

  It would be expected that the costs would be reasonably close to those produced by the FDCM, assuming that the Type 2 CA factor is reasonably accurate. In comparison there is a 10% difference which seems to be a fair assessment. Yet, with the funding and schedule problems envisioned, this may well end up as an optimistic viewpoint.

  No learning curve or difficulty factor has been applied to this building's estimate, as the work was assumed to be straightforward.

- ***Cost Allocations —*** Allowances have been made for several items. For example, as the RCRA Closure Plan was not available at the time of the estimate, an allowance of $500,000 was included in the original estimate. This figure has not been updated since.

  Landlord costs are within the estimate (e.g., hazard reduction and stabilization). These should be removed when comparing this building with other buildings

  K-H calculated the D&D consumables such as small tools as a percentage of the total number of hours worked instead of calculating it based upon those of the workers actually involved in each task. This would not appear to be a good model for estimating.

  The estimate does include costs for PPE and the hours associated with wearing it are built into the estimate. Therefore, the 40 hours per week quoted are not all productive hours.

- ***Characterization*** – Characterization costs have been included in the bottoms-up estimate. Though this is not a major cost for this particular building. The estimate was produced by RMRS, and therefore it was assumed that they would perform this function.

- ***Overtime*** – Decommissioning is broadly based on a 40 hour week with an extra shift added for certain activities. No overtime costs are included.

- ***Schedule Dependent Costs*** – Schedule is dependent on funding. If funding is lower than expected then the schedule will be severely affected. Any slippage in schedule and the associated costs of maintaining the project management and support functions has not been included.

  This building is outside the Protected Area, and deemed less critical than the PA buildings. Therefore it has been adversely affected in its scheduled completion. However, similarly, it should not be overly affected by the need to remove the PA by certain dates.

  The estimate for this building does not appear to be updated with any frequency, even to reflect any delays in schedule.

Recommendations

1. ***Unit Rates*** – The development of the unit rates and resource hours for activities has produced a cause for concern. In some buildings these have been developed by drawing on the experiences of those who are involved in the activities, while others are drawing upon the experience of the estimator, or from actual information provided by already completed buildings. So far amongst the estimates, only Building 771 has produced a series of generic unit rates and resources for each activity. Although this may over-simplify the estimate in some ways, at least it is consistent in its application.

   There is the another extreme, as in Building 776, where each set has been taken on a completely independent basis from the rest of the building, and resources have been determined accordingly. This in some ways is preferable to the generic method, as each set is resourced and costed according to its actual requirements, (i.e., a large glove-box is not costed the same as a small one). However, the detail necessary to understand why sets differ is not always present. Building 779 has in some ways produced a middle ground, where areas were taken on an individual basis but the standard costs were applied for the activities, even though they were adjusted from outside industry sources.

2. ***Risk Factors*** – There has been an inconsistent use of factors in each estimate. Each estimate contains factors that are either included in the rates or applied at certain stages in the estimate's development towards a resource's cost. In buildings 776 and 779, PPE factors for productivity were assigned only to those who were affected by the factors, while in the building 771 estimate PPE factors were applied across the board.

3. ***Learning Curve*** – The factors for learning curve have been applied in different ways. Building 776 has them built into each unit rate, whereas Building 771 applies them when transferred to the BEST system on an annual basis. Building 444 excludes them from its estimate entirely. Of the estimates, Building 779 should be providing a wealth of information to develop a better understanding of the learning curve and the level to which it can be applied, however this does not seem to be the case. Estimates have taken information from Building 779 as a basis for certain activities, but there does not appear to be any analysis of similar tasks to determine whether productivity increases have occurred over the course of its completion. It was assumed that the D&D process for that building was the learning curve.

4. ***Consistency in Content*** – Amongst the estimates there are other inconsistencies. Buildings 444 and 779 contain landlord costs while the others have excluded these. There appears to be little in the way of direction as to how costs should be separated. There are points where there is a cross-over between the landlord and decommissioning costs, and a confusion as to which party is responsible for certain activities, such as characterization. There is no set point at which responsibility changes hands. This needs to be defined.

5. ***Consistency in Allowances*** – In some cases allowances have been provided for the completion of certain work activities, particularly in reference to support activities such as sampling and testing.

These allowances are not consistent between buildings even though actual costs could be taken from already completed or nearly completed buildings such as Building 779.

6. ***Technology Integration*** – One consistency amongst the estimates is their omission of the use of technology that may increase productivity levels and reduce the manpower requirements in buildings. However, this in itself raises concerns regarding the ability to complete the buildings on schedule with the resources currently envisioned, as without technological assistance, a one shift strategy does not allow a rapid enough productivity to meet the 2006 deadline. If technology is required, then it should be included in the estimates, as the use of technology is an assumption upon which K-H relies in meeting its schedule and cost.

7. ***Change Management*** – The tracking of changes to estimates is inconsistent among the estimates reviewed. Only the POWERtool system used for Building 771 requires any changes to be logged in order to be implemented. The others have logged changes, but with the control based on manually created records. It is important that this sort of practice is standardized for all buildings, so that the origins of any alterations are clear.

4.5.2.6 Top-Down Estimate Review

In an attempt to understand the complete scope of work, K-H developed the Facility Disposition Cost Model (FDCM). The FDCM is an order of magnitude estimate with a range of (+50% to –30%). It is an approximate estimate produced from actual, albeit limited, cost information from site decommissioning projects that has been adjusted using scaling factors. This form of estimate is usually used during the infancy of a project.

It is generally accepted that the historic data for D&D work is limited. As a result, K-H relies heavily on the use of actual costs for similar work on the site.

The quantities included in this model were obtained from the Facility Disposition Program Manual, and the Facility Information Management System. Additional information for glove-boxes, piping, and duct costs were based on Building 779 (which is currently being decommissioned). For modeling purposes, the FDCM uses a work breakdown structure ("WBS") to organize decommissioning activities in an integrated framework. Given the complexity and risk associated with a decommissioning effort of this magnitude, the FDCM includes a detailed cost sensitivity analysis that is intended to be used to develop a reasonable level of contingency.

Approach

Based on the review of all available cost related information and several interviews and informal meetings with K-H's D&D group, the assumptions and cost included in the $765 million for decommissioning were substantiated. The assumptions and related cost information that were used to generate the above cost is covered in the FDCM. The FDCM is comprised of ten sections. Of those sections, eight were used to create the model. Those sections include:

- Model Overview;
- Assumptions;
- Work Breakdown Structure;
- Description of the Facilities;
- Resources and Costs;
- Contingency Analysis;
- Results; and,
- Future Improvements to the Model.

Kaiser-Hill's D&D group developed the FDCM. The purpose for the FDCM is to quantify the scope of work, its complexities and to estimate cost via a rough order of magnitude (ROM). Again, it is recognized that there is limited data to support estimates for this type of work.

Analysis and Discussion

The FDCM estimates the cost for the decommissioning for all types of facilities within Rocky Flats using a top down estimate based on empirical data. For the purpose of the FDCM, all the facilities were categorized by type. Because all the facilities onsite are for the most part atypical, the model allows for adjustments to be made to incorporate special features or characteristics. The model relies on the most recent information available describing the physical dimensions and characteristics of the various facilities at RFETS and, to the extent possible, actual decommissioning cost experience. Listed below are the steps used to develop the FDCM.

- ***Identify Key Assumptions*** – In the FDCM's infancy, critical assumptions were identified early as a foundation for the model's structure. As the model matured and additional information was gathered those assumptions were adjusted as appropriate.

- ***Establish the Work Breakdown Structure*** – A standard decommissioning work break down structure ("WBS") was developed to better organize the estimate into a logical format. Attached is the work breakdown structure format.

- ***Classify the various facilities and buildings*** – The various facilities and buildings were classified by type to standardize the estimating process.

- ***Collect Physical information on the various types of buildings*** – As much as possible Kaiser-Hill used the most recent information and costs available in the development of the FDCM. Much of the information comes from the facilities Disposition Program Manual and the Facilities Information Management System, which are the official sources of information for the site. In addition, quantity information was gathered from various sources within the site.

The cost and resource information used in the FDCM comes from various completed decommissioning projects or activities at RFETS. Where RFETS costs are not available, the FDCM uses costs based on detailed bottoms-up estimates (or, if possible, from actual costs from comparable government or commercial projects). As stated earlier, in some cases it was necessary to apply cost factors to account for the different types of facilities. The specific sources of data from actual experience (or analysis) follows.

- ***Building 123*** – The FDCM applies factors to those unit costs to address the different levels of assumed contamination and different types of building construction.

- ***Glove-boxes*** – The glovebox dismantlement costs were derived from the last 11,000 cubic feet left in Building 779.

- ***Mechanical Systems*** – The piping, ducts, and internal tanks cost is based on the current subcontract costs from Building 779 and the best information available from the K-H Project Tam. Until such a time when there is additional information from other Type 3 buildings, the costs for the piping, duct, and tank removal is limited to Building 779.

- ***Miscellaneous D&D Cost Bases*** – The balance of the cost information for the trailers, cooling towers, tents and external tanks is based on existing RFETS cost information.

Assumptions used in the FDCM

The FDCM assumptions are correlated to the forecasted cost in the model. The purpose of the FDCM is to provide a forecast of the decommissioning cost based on physical attributes or dimensions (the area or volume of a building). As such, the forecasted decommissioning costs of individual buildings/facilities or the resources associated with a particular WBS element or building can vary widely. Therefore, the costs developed by the FDCM represent an average cost not an expected cost.

K-H used the following general assumptions in top-down estimating:

- All costs used are unburdened.
- There is no escalation or inflation included.
- The FDCM makes no provision for items such as: SNM Removal, Environmental Remediation, Waste Management, and other clusture closure related items.
- All the decommissioning activities are being conducted in accordance with the existing labor agreements and practices in place.
- Adjustments are included to account for economies of scale for buildings with multiple stories. The assumption is that adding an additional story does not proportionally increase the cost for most of the decommissioning activities.
- The buildings/facilities have been categorized based on the year they were built, pre 1989 facilities are assumed to have a greater level of contamination than post 1989 facilities.
- Building rubble contains no asbestos residues.

In addition to those assumptions, KH incorporated the following "cost factor" considerations in the FDCM:

- The planning and engineering costs are based on a percentage of the total project cost as it relates to actual RFETS experience.
- Characterization has a direct relationship to the dismantlement activity in the WBS.
- The removal of all lead and asbestos is included in the decontamination cost. The unit cost for the removal of those contaminants is based on the removal costs for Buildings 889 and 123. These two buildings were used as they were assumed to be similar in nature to the rest of the buildings on-site.

  Furthermore, the FDCM includes an allowance for miscellaneous materials. The costs for the decontamination of the glove-boxes, piping and internal tanks are not included in the decontaminating costs for the building. The cost for those items is included in dismantlement. The model also includes the cost for size reduction, packaging, and preparation for shipment for the wastes generated during decontamination. Also included is the cost for pre-certification costs incurred prior to transferring responsibility to waste management. Beryllium removal is not included in the costs.
- Included in the dismantlement costs is the assumption that the safety clearance for Building 123 will be the same for the buildings within the PA. The dismantlement costs for the Type 3 and certain Type 2 buildings do not include costs for dismantling glove-boxes, piping, or internal tanks. Dismantlement costs vary greatly between the three building types, this assumption is to account for the removal of process equipment as well as, any ties from the glove-boxes piping, alarms instrumentation and any additional HVAC removal.

  K-H used a cost of $870 dollars per cubic foot of contaminated glove-box (which again is the actual cost for the removal of glove-boxes in Building 779). The demolition and disposal classifies the buildings into four types:

  - Modular;
  - Masonry;
  - Reinforced concrete, and,
  - Massive reinforced concrete.

  Based on these types of buildings, the costs are factored according to the levels of difficulty involved. Costs are included in the model for the disposal of all uncontaminated building rubble to a sanitary landfill. There were no adjustments made for scrap or salvage values. The costs for the removal of all building pads, slabs, and footings are included in this unit cost.

  It should be noted that K-H excluded the following landlord activities: cluster compliance and surveillance, baseline maintenance, operations management, technical support, and maintenance required for the continued operations of building systems required for the support of the decommissioning of the buildings. Also excluded from the cost model is the cost for any special security requirements needed for uncleared personnel to perform work inside the protected area.

Work Breakdown Structure

A standard WBS was created to be used for the decommissioning of the site complete. The WBS elements are as follows:

- ***Planning & Engineering***: The scope for this element includes but is not limited to activities such as the preparation of the execution plan, the operation plan, health and safety plan, quality assurance plan, quality control/quality assurance plans, and the like.

- ***Characterization***: This element addresses the tasks specific labor, materials, equipment, and subcontracts associated with the costs for characterization of a decommissioning project. The level of effort included in this WBS does not include the characterization required for Environmental Remediation.

- ***Site Preparation***: This element addresses all the tasks associated with the preparation of the site for a decommissioning project.

- ***Decontamination***: This element addresses all the tasks specific to the costs for the decontamination of a decommissioning project. The scope of this element includes the decontamination of the buildings' interiors and exterior surfaces, equipment, etc. This element also includes the package and preparation of waste, however, it is assumed that once the waste is packaged it becomes the responsibility of the waste management group. The decontamination effort for the gloveboxes, piping and the internal tanks is included in the dismantlement activity.

- ***Dismantlement***: Where applicable this element addresses the tasks specific to the dismantlement of a decommissioning project. The scope of this element includes activities such as strip-out, removal, and size reduction of miscellaneous systems such as building lighting, water systems, and the like, as well as, the isolation of the building from the rest of the site.

- ***Demolition and Disposal***: Where applicable this element addresses the tasks specific to the demo and disposal of a decommissioning project. This scope includes items such as the D&D of structural and non-structural components, roofs, slabs, pads, and any connecting structures.

- ***Project Management***: Where applicable this element addresses the tasks specific to the project management of a decommissioning project. This scope includes items such as construction management, project engineering, project reporting, project controls and document control..

- ***Support Services***: Where applicable this element addresses the tasks specific to the support of a decommissioning project. This scope includes services such as training, security, contract administration, radiological operations, medical health and safety support, regulatory interface and the like.

Cost Associated with the WBS

The unit costs and resources used in the FDCM were generated from a wide range of sources. When possible, the costs were based on completed or ongoing RFETS related projects. When cost information was not available from the site, actual cost from other like projects were used. If no other information was available a detailed conceptual estimate was used. Specifics are detailed below.

- ***Planning and Engineering Costs*** – The planning and engineering costs are based on a percentage of the total cost of the work and therefore are directly related to the size and difficulty of the building. It is assumed that the P&E costs do not change with buildings of different construction types.

- ***Characterization*** – The level of effort required to characterize a building is again directly related to the complexity of the building and the contaminants contained in the individual buildings. Because the cost for characterization is directly proportional to the level of contamination in a given building the cost can range from approximately 40% to 55% of the total dismantlement cost.

- ***Site Preparation*** – The site preparation costs are based on a fraction of the total project cost and are directly related to the size of the building. The FDCM uses three percent of the total cost. The FDCM assumes that the cost for site preparation does not change between buildings of different construction types.

- ***Decontamination*** – The costs for the decontamination of the various types of building is based on the various levels of contamination found in the buildings. The decontamination costs are estimates based on the square footage of the particular building area. The FDCM adjusts the unit cost based on a portion of the buildings interior surfaces needing no decontamination.

- ***Dismantlement*** – The dismantlement costs are based on the costs derived from actual costs for work at RFETS. The dismantlement of the gloveboxes, piping, and the internal tanks is based on the information gathered from building #779. The dismantlement costs for the external tanks were taken from two oil tanks T221 and 224 and two acid tanks 218-1 and 218-2. The dismantlement for all the building types is the actual dismantlement cost for building #123. For the various building types, a factor was applied to account for the different levels of difficulty.

- ***Demolition and Disposal*** – The unit cost for demo and disposal assumes that the buildings are clean. The actual unit cost is developed from the demolition of building #123which is a Type 2 masonry building. Because it is assumed that all buildings are clean the same unit rate was applied to the Type 1 and Type 3 buildings as well. Based on the various types of buildings the unit costs were factored to account for the varying degrees of difficulty. With respect to the massive reinforced concrete buildings it was assumed that its cost would be 60% greater than the unit costs for a reinforced concrete building.

- ***Project Management*** – The cost for project management is based on data gathered from 23 previous construction projects at the RFETS. Those 23 projects were divided into the three categories within the FDCM. Based on the information gathered from various project summary reports, it was determined that for a Type 1 building, the PM cost is 11% of the total cost. For a Type 2 the PM cost was 13% of the total cost and for a Type 3 the PM cost was 16% of the total project cost. The historical data used was from non contaminated buildings and therefore was adjusted accordingly for the varying degrees of difficulty.

- ***Support Services –*** The cost and resources for the support services for the decommissioning activities is directly related to the complexity of the building structure and the contaminants contained within.

Commentary

- Although limited, actual cost information was incorporated into the FDCM model and adjusted to reflect building complexities.
- The cost model assumes that the PA will be taken down in a timely manner. There are no provisions to address the eventuality that this may not occur, that is, K-H did not investigate the impact of delayed closure.
- While a contingency was calculated based on the final cost in the FDCM, the contingency has not been directly transferred into BEST.
- It should again be noted that K-H acknowledges that the FDCM forecast is a "rough order of magnitude" within a plus 50% to a minus 30% range. Expectations for its accuracy should be set accordingly.
- The PBD's identify multiple shift work whereas the FDCM and the bottoms up estimates do not make allowances for shift work.
- K-H set soft costs on a "percentage of cost" basis. Actual costs could be greater than allowed in the FDCM.
- The FDCM assumes that once the building has been deactivated, it will be ready for decommissioning work. Based on the experience with Building 123 this appears to be an optimistic assumption.

- The FDCM's total cost is based on FY99 dollars and includes no escalation or inflation as a majority of the work is to be performed in the out-years.
- The FDCM model assumes a learning curve for Type 1 and 2 buildings. However due to the complexities expected with Type 3 buildings, learning curve savings are excluded.
- The FDCM is considered to be a forecasting, funding, cash flow, and benchmarking tool. It is not a formal estimate for the D&D costs. Additionally it was created to establish credibility to the base line.
- The FDCM was also established to provide K-H with a look ahead for the resources needed in the out-years.

Recommendations

- As more actual cost information becomes available, the FDCM should be updated in an effort to provide a more accurate forecast of the potential final cost.
- Based on the availability of more relevant cost information from Building 779, a Type 3 building, K-H should develop cost models specific to the three types of buildings on site.
- After review of the factors and assumptions used in the development of the glove-box cost, the FDCM should include a factor to address the varying degrees of difficulty involved.
- As more cost data is provided, the FDCM should begin to incorporate learning curves into the various cost models.

4.5.2.7 Basis of Estimate Software Tool (BEST) Interface

The BEST system facilitates the collection and storage of decommissioning cost data, factors and quantities, and retrieves FDCM information. The primary purpose of BEST is to document and integrate cost estimates in a standard format for planned work related to the 2006 closure (see attachment for process flow in prior section). Some key BEST goals are to:

- Make planning tasks easier by automating calculations and reducing paperwork.
- Collect data in a standardized format, so that the data can be readily transferred to other information systems such as P3 scheduler.
- Ensure that data is consistent and validated to the fullest extent possible.

Background

The BEST system has been set up to track costs and work scope from the FDCM "order of magnitude" estimate relative to the initial bottoms-up estimates. Furthermore, it will be used to monitor project life-cycle costs through the change management process. To understand the correlation between the D&D group estimate, how this information compiled and what is reported to the K-H

Management and DOE in the 2006 Baseline Estimate, it was important to ensure that costs were loaded into the BEST system completely and accurately. This procedure was performed to guarantee that all estimated costs are being captured in addition to ensuring that the flow of information for K-H's systems is accurate and reliable.

FDCM uses an "equivalent area" approach to estimating. This means that K-H has standardized unit costs and manipulates actual areas or volumes to address variance in degree of difficulty or complexity. As a result, unit rates were standardized and remain consistent across WBS elements. For example, when estimating removal of 100 lineal feet of conduit, the unit price basis for non-contaminated conduit may be $2.00 per lf. If the conduit was contaminated, the system would require that the conduit length be adjusted upward to obtain the cost increase.

Approach

Due to the unusual nature of this technique (that is, it utilizes a standard unit cost and allows adjustments to be made to quantities, scope or component characteristics) we employed the following procedures to assess BEST:

- Accessed the CE_DDR2 file within the Joshua reporting system and downloaded $895 million of detailed D&D costs estimated solely by the FDCM.
- Reconciled and noted any estimated cost differences in excess of 2%± of the total D&D. Specifically, we compared estimates between the FDCM (file:CE_DDR2) and the D&D portion of 2006 baseline plan (file:2006_Rev2 - which includes both FDCM method estimating and the bottoms-up detailed cost estimates).
- Verified that unit rates remain consistent for all like WBS elements within the FDCM estimates.

Comments

Through performance of these procedures it was determined that the information within the BEST system portrays an accurate description and detail to the cost estimates performed by the K-H D&D group members.

1. Based upon our current understanding of D&D planning, we found that the $755 million D&D cost estimates identified in BEST are attributable to the following:

    - 40% of cost determined through bottoms-up estimates.
    - 60% determined through the FDCM developed estimates

2. Results of the CE_DDR2 download provided approximately 500 pages of estimate detail for each building cluster and was organized by PBD, WAD and finally by activity. Comparison of this information to the 2006 baseline (contained in the BEST system under file:2006_Rev2) disclosed some inconsistancies and differences. K-H team members provided acceptable explanations for these differences.

3. It was determined that the "equivalent areas" approach used when transferring estimate information from the FDCM to BEST, while not common, is reasonable and provides accurate results within the system. The procedure of testing unit rates across WBS elements resulted in no discrepancies.

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